CHROMOSOME NUMBERS IN THE ERIOPHYLLUM LANATUM (COMPOSITAE, HELENIEAE) COMPLEX

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Eriophyllum lanatum (Pursh) Forbes is a species-complex consisting of at least 10 ill-defined regional varieties that range from southern California to British Columbia, Montana and Wyoming. Constance (1937) noted that of the 157 binomials and trinomials which had been applied to members of *Eriophyllum,* 75 were referable to *E. lanatum.* Carlquist (1956) recorded chromosome counts of **n = 8** and **n = 16** in 2 of the varieties of *E. lanatum,* and observed that additional studies should prove interesting. My interest in the *E. lanatum* complex stems partly from my studies of the *Chaenactis douglasii* complex (Mooring, 1965; and unpublished). Both of these Helenieae have approximately the same geographic distribution, ecologic amplitude, life span and degree of taxonomic complexity. Among other items, I wished to compare the geographic distribution of diploids and polyploids in *E. lanatum* with that known for *C. douglasii,* in which a remarkable correlation exists between ploidy level and geographic distribution.

The purpose of this paper is to present the chromosome counts obtained in the first part of this study, and to suggest the direction of further research.

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Materials and Methods

Young heads from wild or garden plants were fixed either in 1:3 acetic-alcohol or in 1:3:6 acetic-chloroform-alcohol. Chromosome counts were obtained from pollen mother cells squashed in acetocarmine. Specimens have been deposited in the University of Santa Clara Herbarium and replicates of most of them will be distributed elsewhere.

Results

Table 1 shows my chromosome counts. Figure 1 shows my counts, those of Carlquist (1956) and one provided by Peter Raven (letter). The counts of **2n = c. 48** in *E. lanatum* var. *achillaeoides,* all the counts in vars. *aphanactis, croceum, cuneatum, integrifolium, lanatum, lanceolatum* and *leucophyllum,* and those for the putative hybrid between var. *arachnoideum* and *E. confertiflorum* are first reports. Meiosis was sometimes unclear in PMC's from wild plants, especially at the tetraploid and hexaploid level. Bivalents seemed the rule, although *1028* and *1032* had an occasional association of 4 chromosomes, *1455, 1590, 1642* and *Raven 20294* each had a small supernumerary chromosome, and *1024* had a small pair of extra chromosomes.

TABLE 1. CHROMOSOME COUNTS IN ERIOPHYLLUM

Collection numbers are my own, unless otherwise stated.

E. lanatum (Pursh) Forbes var. *lanatum*. **2n = 16**. Idaho. Idaho Co., Kamiah, *1122*. Oregon. Wallowa Co., Grand Ronde Canyon, *1107*. Washington. Clark Co., Battleground, *1586;* Yakima Co., American River, *1600*.

var. *achillaeoides* (DC.) Jepson. **2n = 16**. California. Contra Costa Co., Mt. Diablo, *1028;* Glenn Co., Stonyford, *1532;* Humboldt Co., Garberville, *1574;* Santa Clara Co., Loma Prieta, *1375;* Siskiyou Co., Grass Lake, *1676;* Trinity Co., Douglas City, *1495*. Oregon. Klamath Co., Modoc Point, *1665*. **2n = 32**. California. Colusa Co., Leesville, *1535;* Tehama Co., Beegum, *1517*. **2n = c. 48**. California. Mendocino Co., Hopland, *1032*.

var. *aphanactis* Howell. **2n = 32**. California. Glenn Co., Elk Creek, *1520;* McGrew Springs, *1525*.

var. *arachnoideum* (Fisch. & Ave.-Lall.) Jepson. **2n = c. 16**. California. San Mateo Co., Bear Gulch Road, *1557*.

var. *croceum* (Greene) Jepson. **2n = 32**. California. Nevada Co., Banner Hill, *1002, 1005*.

var. *cuneatum* (Kell.) Jepson. **2n = c. 32**. California. Nevada Co., Cisco Grove, *1150, 1151*.

var. *grandiflorum* (Gray) Jepson. **2n = 16**. California. Amador Co., Jackson, *1467;* Calaveras Co., Murphys, *1455;* Del Norte Co., Klamath Glen, *1039, 1040, 1043;* Idlewild, *1048;* El Dorado Co., Pollock Pines, *1471;* Mariposa Co., Bagby, *1430;* Nevada Co., Banner Hill, *1010;* Placer Co., Auburn, *1021;* Shasta Co., Whiskeytown Creek, *1490;* Platina, *1510;* Siskiyou Co., Black Butte Summit, *1681;* Trinity Co., Douglas City, *1502; 1506;* Tuolumne Co., Stent, *1445;* Twainharte, *1450*. **2n = 32**. California. Butte Co., Oroville, *1476;* Shasta Co., Millville, *1481*.

var. *integrifolium* (Hook.) Smiley. **2n = 16**. California. Tuolumne Co., Kennedy Meadows, *Raven 20294* (DS). Idaho. Owyhee Co., Jump Creek Canyon, *1351, 1352*. Oregon. Baker Co., Dooley Mountain, *1094;* Deschutes Co., Sisters, *1059;* La Pine, *1642;* Grant Co., Canyon City, *1079;* Klamath Co., Collier State Park, *1650*. Wyoming. Fremont Co., Togwotee Pass, *1301*.

var. *lanceolatum* (Howell) Jepson. **2n = 16**. California. Trinity Co., Mountain Meadows Ranch, *1712*. Oregon. Josephine Co., Oregon Caves, *1053*.

var. *leucophyllum* (DC.) W. R. Carter. **2n = 32**. Washington. Lewis Co., Toledo, *1590*.

var. *arachnoideum* (Fisch. & Ave.-Lall.) Jepson × *E. confertiflorum* (DC.) Gray. California. San Mateo Co., Black Mountain, *1024* (**2n = c. 32–40**), *1027* (**2n = 50**).

E. confertiflorum (DC.) Gray. **2n = 16**. California. Los Angeles Co., La Cañada, 5525 Alta Cañada, *1365;* San Bernardino Co., Fredalba, *1360*.

DISCUSSION

At this time my results merely extend the investigations begun by Constance (1937) and Carlquist (1956). *Eriophyllum lanatum* var. *grandiflorum* includes diploids and tetraploids, and var. *achillaeoides* diploids, tetraploids and hexaploids. The other varieties of the *E. lanatum* complex for which counts are available appear to consist of diploids *(arachnoideum, integrifolium, lanatum, lanceolatum)* or of tetraploids *(aphanactis, croceum, cuneatum, leucophyllum)*. My 2 counts for *E. confertiflorum* are in line with Carlquist's (1956) results: **n = 8** for southern California mainland material. Further counts may well change these impressions.

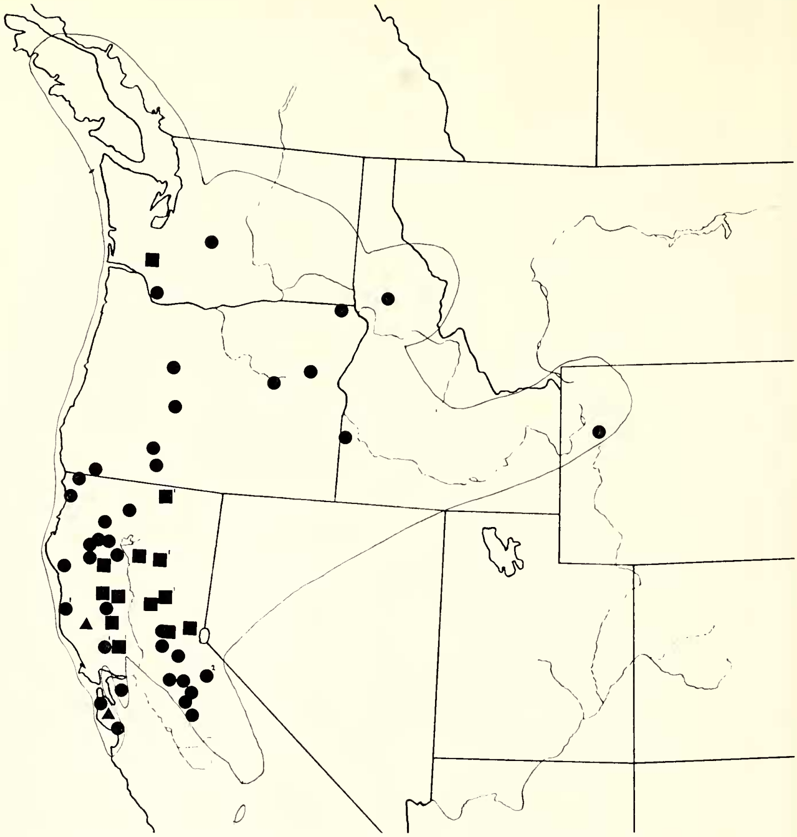

FIG. 1. Distribution of diploids (circles), tetraploids (squares) and hexaploids (triangles) in the *E. lanatum* complex. Symbols marked "1" derived from Carlquist (1956), that marked "2" of *Raven 20294,* all other counts my own. Range of the complex shown in outline.

The paucity of chromosome counts provides small basis for speculation about the evolutionary role of polyploidy in the *E. lanatum* complex. In most instances only one plant per population has been examined cytologically. So far, however, only one polyploid has been found outside California, and no evidence exists that polyploidy has been mainly responsible for the development of the complex as a whole. Available data do suggest, however, that polyploidy has contributed occasionally, sometimes by promoting interbreeding and elsewhere by inhibiting it. For example, var. *cuneatum* may be of alloploid origin. It is in many ways intermediate between vars. *grandiflorum* and *integrifolium,* and occurs in a relatively narrow zone between them. Chromosome counts of Cisco Grove plants show them to be tetraploids, whereas counts in *grandiflorum* and *integrifolium* reveal only diploids, at least near the range of *cuneatum.* Polyploidy also may have promoted morphologic divergence by decreasing interbreeding where varieties exist sympatrically. At Banner Hill, where they grow in a mixed colony, vars. *croceum* and *grandiflorum* differ sharply morphologically, phenologically and chromosomally, and, to a lesser extent, ecologically. Counts show *croceum* to be tetraploid and *grandiflorum* diploid. Varieties *achillaeoides* and *aphanactis* may represent a similar situation. The latter apparently is essentially a rayless expression of the former, but counts show it to be tetraploid, whereas, *achillaeoides* may be diploid, tetraploid or hexaploid. Elsewhere, however, varieties may exist sympatrically or nearly so, maintain their integrity, and yet have, apparently, the same chromosome number. This appears to be the situation near Weaverville and near Weed for vars. *achillaeoides* and *grandiflorum*. It is quite clear that much additional work is needed before much can be said about either the role of polyploidy in the complex or the taxonomic status of the "varieties." The foregoing remarks merely represent possible conclusions to be drawn from the scanty data, and suggest the direction of future research. Obviously, much remains to be done, especially in northwestern California-southwestern Oregon, the central Sierra Nevada, and in the synonomy-ridden and wide-ranging var. *integrifolium*.

Eriophyllum lanatum apparently hybridizes with *E. confertiflorum* (Constance, 1937; Thomas, 1961), and *E. jepsonii* Greene and *E. latilobum* Rydb. possibly arose, independently, from these sources (Constance, 1937; Munz, 1959). I have found 2 localities where *E. lanatum* apparently hybridizes with *E. confertiflorum*. In one it is via var. *arachnoideum*, in the other via var. *achillaeoides*. The former population is the source of the $2n = 32–40$ and $2n = 50$ counts in Table 1. These populations will receive further study.

Eriophyllum seems to be a rapidly evolving genus. The *E. lanatum* complex appears to be ancestral or near-ancestral to the rest of the genus, and perhaps to *Monolopia* and other closely related genera as well, as Constance (1937), without benefit of chromosome number information, speculated a generation ago. Hopefully, further study will clarify the biologic and taxonomic situation in the *E. lanatum* complex, and perhaps lead to a better understanding of *Eriophyllum* and of the subtribe Eriophyllanae.

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